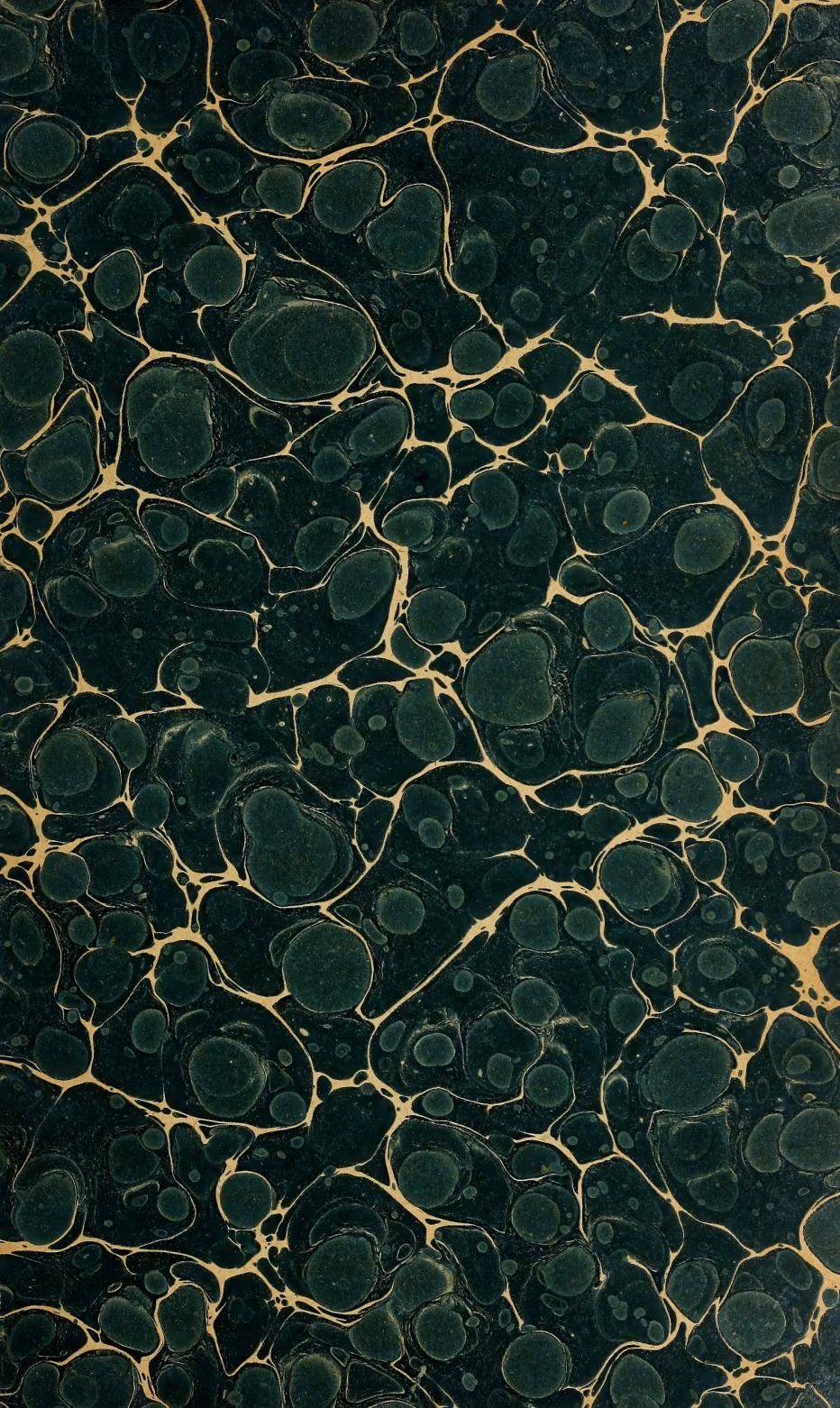

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United States Department of Agriculture,

BUREAU OF ENTOMOLOGY,

L. O. HOWARD, Entomologist and Chief of Bureau.

HOUSE FLIES.

(*Musca domestica* et al.)

By L. O. HOWARD.

There are several species of flies which are commonly found in houses, although but one of these should be called the house fly proper. This is the *Musca domestica* L. (fig. 1) and is a medium-sized, grayish fly, with its mouth parts spread out at the tip for sucking up liquid substances. It breeds in manure and dooryard filth and is found in nearly all parts of the world. On account of the conformation of its mouth

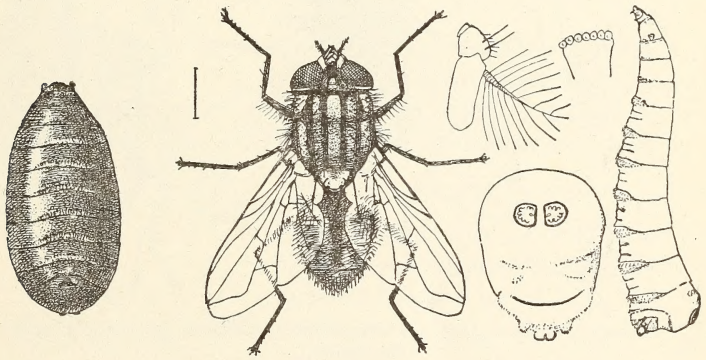

FIG. 1.—Common house fly (*Musca domestica*): Puparium at left; adult next; larva and enlarged parts at right. All enlarged (author's illustration).

parts, the house fly can not bite, yet no impression is stronger in the minds of most people than that this insect does occasionally bite. This impression is due to the frequent occurrence in houses of another fly (*Stomoxys calcitrans* L.) (fig. 2), which is called the stable fly, and which, while closely resembling the house fly (so closely, in fact, as to deceive anyone but an entomologist), differs from it in the important particular that its mouth parts are formed for piercing the skin. It is perhaps second in point of abundance to the house fly in most portions of the Northeastern States.

A third species, commonly called the cluster fly (*Pollenia rudis* Fab.), is a very frequent visitant of houses, particularly in the spring and fall. This fly is somewhat larger than the house fly, with a dark-colored, smooth abdomen and a sprinkling of yellowish hairs. It is not so active as the house fly and, particularly in the fall, is very sluggish. At such

times it may be picked up readily and is very subject to the attacks of a fungous disease which causes it to die upon window panes, surrounded by a whitish efflorescence. Occasionally this fly occurs in houses in such numbers as to cause great annoyance, but such occurrences are comparatively rare.

A fourth species is another stable fly, known as *Muscina stabulans* Fall. (fig. 3), a form which almost exactly resembles the house fly in general appearance, and which does not bite as does the biting stable fly. It breeds in decaying vegetable matter and in excrement.

Several species of metallic greenish or bluish flies are also occasionally found in houses, the most abundant of which is the so-called blue-bottle fly (*Calliphora erythrocephala* Meig.). This insect is also called the blow-fly or meat-fly and breeds in decaying animal material. A smaller species, which may be called the small blue-bottle fly, is *Phormia*

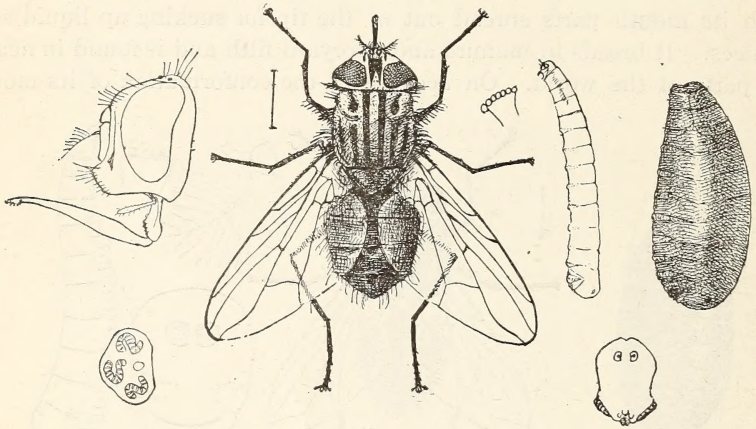

FIG. 2.—*Stomoxys calcitrans:* Adult, larva, puparium, and details. All enlarged (author's illustration).

terrænovæ Desv. (fig. 4); and a third, which is green in color and about the size of the large blue-bottle, is *Lucilia cæsar* L. (fig. 5).

There is still another species, smaller than any of those so far mentioned, which is known to entomologists as *Homalomyia canicularis* L., sometimes called the small house fly. A related species, *H. brevis* Rond., is shown in figure 6. *H. canicularis* is distinguished from the ordinary house fly by its paler and more pointed body and conical shape. The male, which is much commoner than the female, has large pale patches at the base of the abdomen, which are translucent when the fly is seen on a window pane. It is this species that is largely responsible for the prevalent idea that flies grow after gaining wings. Most people think that these little Homalomyias are the young of the larger flies, which, of course, is distinctly not the case.

Still another fly, and this one is still smaller, is a jet-black species known as the window fly (*Scenopinus fenestralis* L.), which in fact has

become more abundant of later years. It breeds in the dust under carpets, and its larva is a white, very slender, almost thread-like creature.

In the autumn, when fruit appears on the sideboard, many specimens of a small fruit-fly (*Drosophila ampelophila* Loew) (fig. 7) make their appearance, attracted by the odor of overripe fruit.

A small, slender fly is not infrequently seen in houses, especially upon window panes. This is *Sepsis violacea* Meig., shown enlarged in figure 8.

All of these species, however, are greatly dwarfed in numbers by the common house fly. In 1900 the writer made collections of the flies in dining rooms in different parts of the country, and out of a total of 23,087 flies 22,808 were *Musca domestica*, that is, 98.8 per cent of the whole number captured. The remainder, consisting of 1.2 per cent of the whole, comprised various species, including those mentioned above.

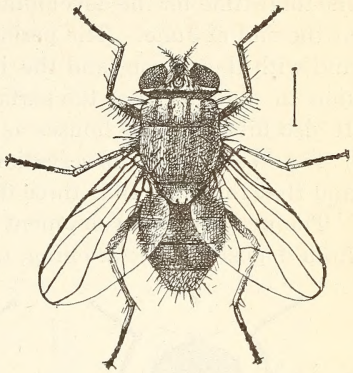

FIG. 3.—*Muscina stabulans*, enlarged (author's illustration).

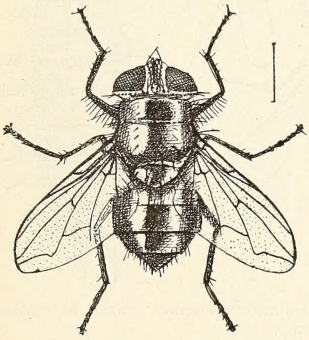

FIG. 4.—*Phormia terrænovæ*, enlarged (author's illustration).

LIFE HISTORY OF THE TRUE HOUSE FLY.

Musca domestica commonly lays its eggs upon horse manure. This substance seems to be its favorite larval food. It will oviposit on cow manure, but we have not been able to rear it in this substance. It will also breed in human excrement, and from this habit it becomes very dangerous to the health of human beings, carrying, as it does, the germs of intestinal diseases such as typhoid fever and cholera from excreta to food supplies. It will also lay its eggs upon other decaying vegetable and animal material, but of the flies that infest dwelling houses, both in cities and on farms, a vast proportion comes from horse manure.

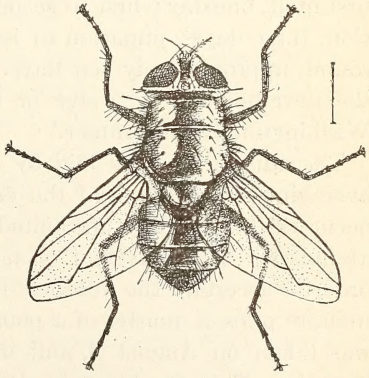

FIG. 5.—*Lucilia cæsar*, enlarged (author's illustration).

At Salem, Mass., Packard states that he bred a generation in fourteen days in horse manure. The duration of the egg state was twenty-

four hours, the larval state from five to seven days, and the pupal state from five to seven days. At Washington the writer has found in midsummer that each female lays about 120 eggs, which hatch in eight hours, the larva period lasting five days and the pupa five days, making the total time for the development of the generation ten days. This was at the end of June. The periods of development vary with the climate and with the season, and the insect hibernates in the puparium condition in manure or at the surface of the ground under a manure heap. It also hibernates in houses as adult, hiding in crevices.

The Washington observations indicate that the larvæ molt twice, and that there are thus three distinct larval stages.

The periods of development were found to be about as follows: Egg from deposition to hatching, one-third of a day; hatching of larva to

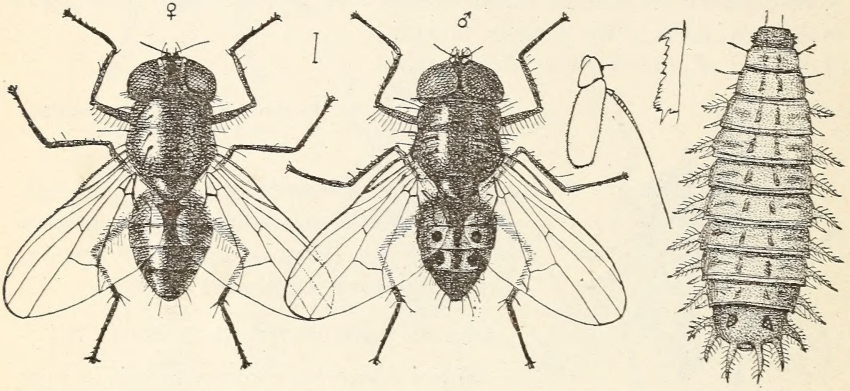

FIG. 6.—*Homalomyia brevis:* Female at left; male next, with enlarged antenna; larva at right. All enlarged (author's illustration).

first molt, one day; first to second molt, one day; second molt to pupation, three days; pupation to issuing of the adult, five days; total life round, approximately ten days. There is thus abundance of time for the development of twelve or thirteen generations in the climate of Washington every summer.

The number of eggs laid by an individual fly is undoubtedly large, averaging about 120, and the enormous numbers in which the insects occur is thus plainly accounted for, especially when we consider the abundance and universal occurrence of appropriate larval food. In order to ascertain the numbers in which house-fly larvæ occur in horse-manure piles, a quarter of a pound of rather well-infested horse manure was taken on August 9, and in it were counted 160 larvæ and 146 puparia. This would make about 1,200 house flies to the pound of manure. This, however, can not be taken as an average, since no larvæ are found in perhaps the greater part of ordinary horse-manure piles. Neither, however, does it show the limit of what can be found, since about 200 puparia were found in less than 1 cubic inch of manure taken

from a spot 2 inches below the surface of the pile where the larvæ had congregated in immense numbers. The different stages of the insect are well illustrated in figure 1 and need no description.

REMEDIES AND PREVENTIVES.

A careful screening of windows and doors during the summer months, with the supplementary use of sticky fly papers, is a preventive measure against house flies known to everyone, and there seems to be little hope in the near future of much relief by doing away with the breeding places. A single stable in which a horse is kept will supply house flies for an extended neighborhood. People living in agricultural communities will probably never be rid of the pest, but in cities, with better methods of disposal of garbage and with the lessening of the number of horses and horse stables consequent upon electric street railways, bicycles, and automobiles, the time may come, and before very

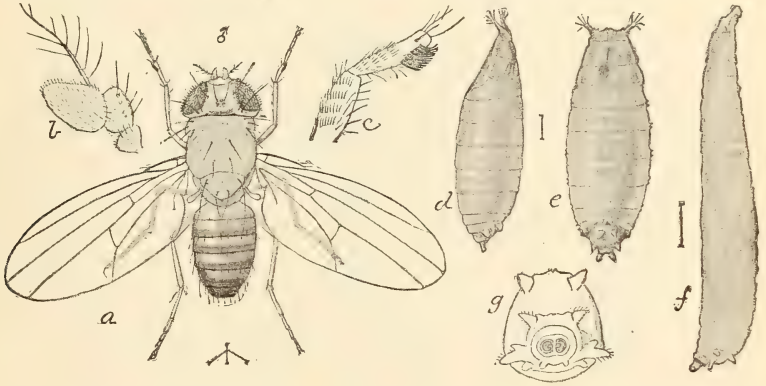

FIG. 7.—*Drosophila ampelophila: a*, adult; *b*, antenna of same; *c*, base of tibia and first tarsal joint of same; *d*, puparium, side view; *e*, puparium from above; *f*, full-grown larva; *g*, anal spiracles of same. All enlarged (author's illustration).

long, when window screens may be discarded. The prompt gathering of horse manure, which may be variously treated or kept in a specially prepared receptacle, would greatly abate the fly nuisance, and city ordinances compelling horse owners to follow some such course are desirable. Absolute cleanliness, even under existing circumstances, will always result in a diminution of the numbers of the house fly, and, in fact, most household insects are less attracted to the premises of what is known as the old-fashioned housekeeper than to those of the other kind.

During the summer of 1897 a series of experiments was carried out with the intention of showing whether it would be possible to treat a manure pile in such a way as to stop the breeding of flies. The writer's experience with the use of air-slaked lime on cow manure to prevent the breeding of the horn fly suggested experimentation with different

lime compounds. It was found to be perfectly impracticable to use air-slaked lime, land plaster, or gas lime with good results. Few or no larvæ were killed by a thorough mixing of the manure with any of these three substances. Chlorid of lime, however, was found to be an excellent maggot killer. Where 1 pound of chlorid of lime was mixed with 8 quarts of horse manure, 90 per cent of the maggots were killed in less than twenty-four hours. At the rate of a quarter of a pound of chlorid of lime to 8 quarts of manure, however, the substance was found not to be sufficiently strong. Chlorid of lime, though cheap in Europe, costs at least 3½ cents a pound in large quantities in this country, so that the frequent treatment of a large manure pile with this substance would be out of the question in actual practice.

Experiments were therefore carried on with kerosene. It was found

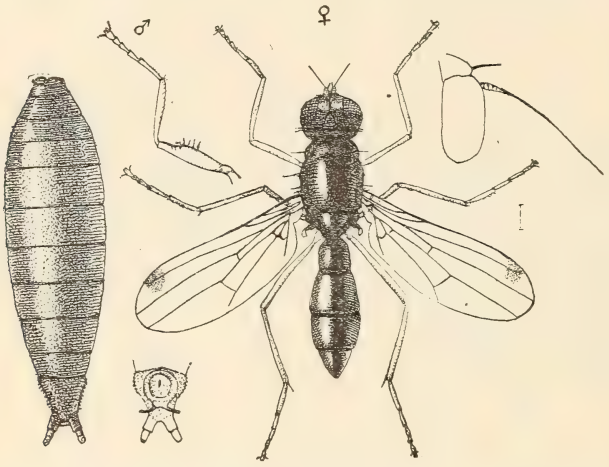

FIG. 8.—*Sepsis violacea:* Adult with enlarged antenna at right; puparium at left. All enlarged (author's illustration).

that 8 quarts of fresh horse manure sprayed with 1 pint of kerosene, which was afterwards washed down with 1 quart of water, was thoroughly rid of living maggots. Every individual was killed by the treatment. This experiment and others of a similar nature on a small scale were so satisfactory that it was considered at the close of the season that a practical conclusion had been reached, and that it was perfectly possible to treat any manure pile economically and in such a way as to prevent the breeding of flies.

Practical work in the summer of 1898, however, demonstrated that this was simply another case where an experiment on a small scale has failed to develop points which in practical work would vitiate the results.

The stable of the U. S. Department of Agriculture, in which about twelve horses are kept, is situated about 100 yards behind the main building of the Department and about 90 yards from the building in

which the Bureau of Entomology is situated. This stable has always been very carefully kept. The manure was thoroughly swept up every morning, carried outside of the stable, and deposited in a pile behind the building. This pile, after accumulating for a week or ten days, or sometimes two weeks, was carried off by the gardeners and spread upon distant portions of the grounds. At all times in the summer this manure pile swarmed with the maggots of the house fly. It is safe to say that on an average many thousands of perfect flies issued from it every day, and that at least a large share of the flies which constantly bothered the employees in the two buildings mentioned came from this source.

On the basis of the experiments of 1897, an attempt was made, beginning early in April, 1898, to prevent the breeding of house flies about the Department by the treatment of this manure pile with kerosene. The attempt was begun early in April and was carried on for some weeks. While undoubtedly hundreds of thousands of flies were destroyed in the course of this work, it was found by the end of May that it was far from perfect, since if used at an economical rate the kerosene could not be made to penetrate throughout the whole pile of manure, even when copiously washed down with water. A considerable proportion of house-fly larvæ escaped injury from this treatment, which at the same time was found, even at an economical cost, to be laborious, and such a measure, in fact, as almost no one could be induced to practically adopt.

There remained, however, another measure which had been suggested by the writer in an article on the house fly published in 1895, namely, the preparation of an especial receptacle for the manure, and this was very readily accomplished. A closet 6 by 8 feet had been built in the corner of the stable nearest the manure pile. It had a door opening into the stable proper, and also a window. A door was built in the outside wall of this closet, and the stablemen were directed to place no more manure outside the building; in other words, to abolish the outside manure pile, and in the future to throw all of the manure collected each morning into this closet, the window of which in the meantime had been furnished with a wire screen. The preparations were completed by the middle of June, and a barrel of chlorid of lime was put in the corner of the closet. Since that time every morning the manure of the stable is thrown into the closet, and a small shovelful of chlorid of lime is scattered over it. At the expiration of ten days or two weeks the gardeners open the outside door, shovel the manure into a cart, and carry it off to be thrown upon the grounds.

Judging from actual examination of the manure pile, the measure is eminently successful. Very few flies are breeding in the product of the stable which formerly gave birth to many thousands daily. After this measure had been carried on for two weeks, employees of the Depart-

ment who had no knowledge of the work that was going on were asked whether they had noticed any diminution in the number of flies in their offices. Persons in all of the offices on the first floor of the two buildings were asked this question. In every office except one the answer was that a marked decrease had been noticed, so that the work must be considered to have been successful.

The account of this remedial work has been given with some detail, since it shows so plainly that care and cleanliness combined with such an arrangement as that described will in an individual stable measurably affect the fly nuisance in neighboring buildings.

With the combined efforts of the persons owning stables in a given community, much more effective results can undoubtedly be gained.

In the consideration of these measures we have not touched upon the remedies for house flies breeding in human excrement. On account of the danger of the carriage of typhoid fever, the dropping of human excrement in the open in cities or towns, either on vacant lots or in dark alleyways, should be made a misdemeanor, and the same care should be taken by the sanitary authorities to remove or cover up such depositions as is taken in the removal of the bodies of dead animals. The box privy is always a nuisance from many points of view and is undoubtedly dangerous as a breeder of flies which may carry the germs of intestinal disease. No box privies should be permitted to exist unless they are conducted on the earth-closet principle. With a proper vault or other receptacle, closed except from above, and a free use of fine earth, the breeding of house flies can be prevented. Covering the surface with lime, however, is more certain than the use of earth. The writer has seen, in a large camp of volunteer soldiery, unprotected sinks in which the house fly was breeding by the thousands. He has also seen permanent camps in which the sinks were so constructed and so treated with lime that no house flies whatever were present.

A Parisian journal, the Matin, during the winter of 1905–6, established a prize of 10,000 francs for the best essay on the destruction of the house fly. The jury of competent scientific men awarded the prize to the author of a memoir in which it was proposed to use residuum oil in the destruction of the eggs and larvæ of the fly. This oil is to be used in privies and cesspools. Two liters per superficial meter of the pit is mixed with water, stirred with a stick of wood, and then thrown into the receptacle. It is said to form a covering of oil which kills all the larvæ, prevents the entrance of flies into the pit and, at the same time, the hatching of eggs. It makes a protective covering for the excrement, and this is said to hasten the development of anaerobic bacteria as in a true septic pit, leading in this way to the rapid liquefaction of solid matters and rendering them much more unfit for the development of other bacteria. For manure it is recommended to mix this residuum oil with earth, with lime, and with phosphates, and to spread it at

different times, in the spring by preference, upon the manure of farms and stables and so on.

Practical experimentation with this proposed remedy will be undertaken the coming spring in France.

NATURAL ENEMIES.

The house fly has a number of natural enemies. The common house centipede (fig. 9) destroys it in considerable numbers, there is a small reddish mite which frequently covers its body and gradually destroys it, it is subject to the attacks of hymenopterous parasites in its larval condition, and it is destroyed by predatory beetles at the same time.

The most effective enemy, however, is a fungous disease known as *Empusina muscæ*, which carries off flies in large numbers, particularly toward the close of the season. The epidemic ceases in December, and although many thousands are killed by it, the remarkable rapidity

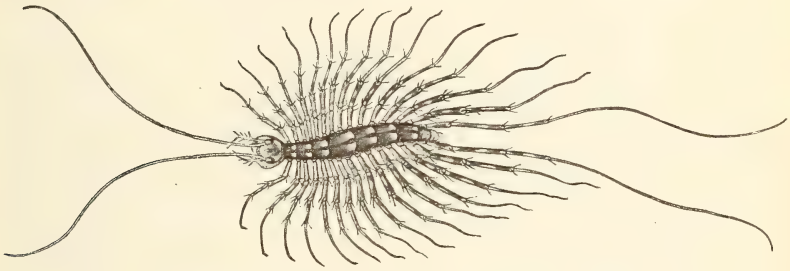

FIG. 9.—*Scutigera forceps:* Adult, natural size (after Marlatt).

of development in the early summer months soon more than replaces the thousands thus destroyed.

WHAT CITIES AND TOWNS CAN DO.

It would appear, from what we know of the life history of the common house fly and from what remedial experimentation has already been carried on, that it is perfectly feasible for cities and towns to so greatly reduce the numbers of these annoying and dangerous insects as to render them of comparatively slight account. The health departments of most of our cities have the authority to abate nuisances dangerous to health, and it is easy for the health authorities of any city to formulate rules concerning the construction and care of stables and the keeping and disposal of manure which, if enforced, will do away with the house-fly nuisance. Such a series of rules was formulated in the spring of 1906 by the Health Department of the city of Asheville, N. C., and an effort is being made during this summer to see that they are enforced. On the 3d of May, 1906, the Health Department of the District of Columbia also issued a series of orders of this nature, on the authority

of the Commissioners of the District, and these orders, which may well serve as a model to other communities desiring to undertake similar measures, may briefly be condensed as follows:

All stalls in which animals are kept shall have the surface of the ground covered with a water-tight floor. Every person occupying a building where domestic animals are kept shall maintain, in connection therewith, a bin or pit for the reception of manure, and, pending the removal from the premises of the manure from the animal or animals, shall place such manure in said bin or pit. This bin shall be so constructed as to exclude rain water, and shall in all other respects be water-tight except as it may be connected with the public sewer. It shall be provided with a suitable cover and constructed so as to prevent the ingress and egress of flies. No person owning a stable shall keep any manure or permit any manure to be kept in or upon any portion of the premises other than the bin or pit described, nor shall he allow any such bin or pit to be overfilled or needlessly uncovered. Horse manure may be kept tightly rammed into well-covered barrels for the purpose of removal in such barrels. Every person keeping manure in any of the more densely populated parts of the District shall cause all such manure to be removed from the premises at least twice every week between June 1 and October 31, and at least once every week between November 1 and May 31 of the following year. No person shall remove or transport any manure over any public highway in any of the more densely populated parts of the District except in a tight vehicle which, if not inclosed, must be effectually covered with canvas, so as to prevent the manure from being dropped. No person shall deposit manure removed from the bins or pits within any of the more densely populated parts of the District without a permit from the health officer. Any person violating any of the provisions shall, upon conviction thereof, be punished by a fine of not more than $40 for each offense.

As with all such measures, the test comes with the enforcement, and during the present summer these regulations have not been well enforced, owing to the extremely small corps of inspectors allowed to the Health Department, and to other more pressing work. They can be made effective, however, and it is earnestly hoped that not only Washington but other communities as well will very soon be brought to a realization of the ease of house-fly eradication and its very great desirability.

Approved:

JAMES WILSON,

Secretary of Agriculture.

WASHINGTON, D. C., *September 21, 1906.*

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